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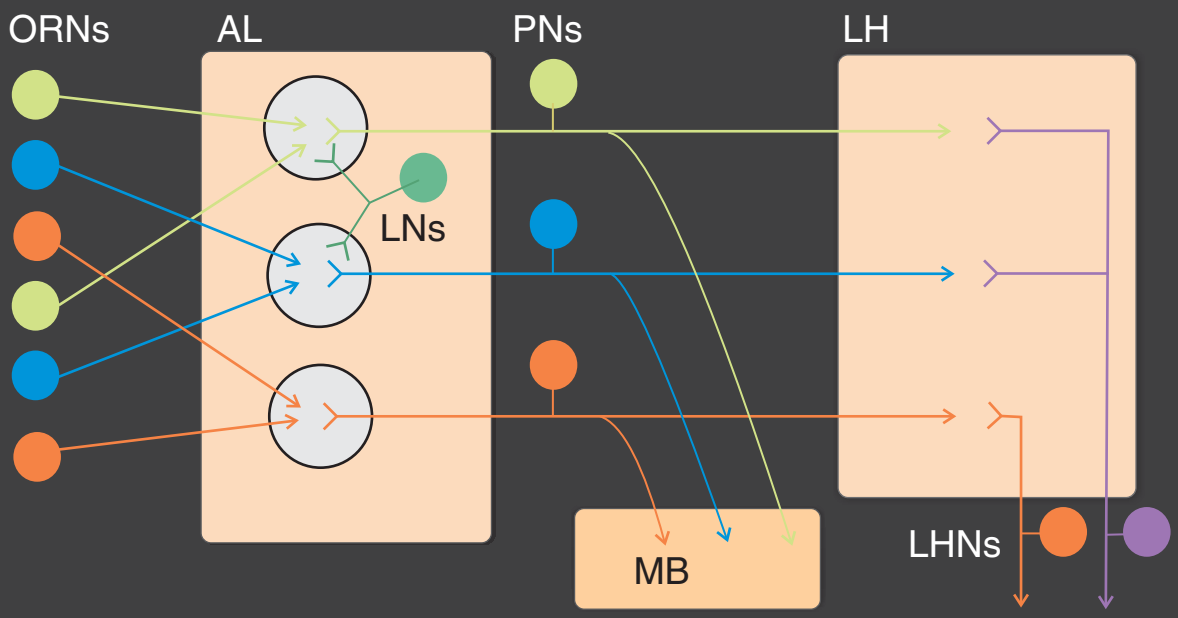
R&D Newsletter

Indian Institute of Technology Kanpur



Schematic of Insect Olfactory System Page 3

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ICAG Corner

ICAG Talk Series

In the Industry Connect Talk Series, organized by the Industrial Collaboration Advisory Group (ICAG), speakers from the industry are invited to present their company's research areas of interest to explore possibilities of collaboration with researchers at IIT Kanpur.

Dr. Debdutta Bandyopadhyay, General Manager and the Head of In-vitro and Cell Biology division in the R&D wing of Zydus Cadila, delivered a talk on 19th August, 2016. The title of the talk was 'Industry and Academia: The inseparable sides of a coin". Zydus Cadila is an Ahmedabad based pharmacy company. The company is in operation for more than 60 years. It has launched Lipaglyn, the first New Chemical Entity (NCE), discovered and developed in India. The company ranks among the top 5 Pharmaceutical companies in India. Zydus had got a very strong pipeline of NCEs and biologics.

Visit of LG Soft India Private Ltd.

A team from LG Soft India Private Ltd (LGSI) visited and had meeting with interested faculty members of IIT Kanpur on 26th May 2016. LGSI, the R&D Centre of LG Electronics, is working in the areas of mobile phones, smart TV, wearable devices, smart car, etc. The objective of the visit was to introduce LGSI to the faculty members. The identified problem statements for possible collaboration include Audio Content Analyzer, 3D Reconstruction, Real Time Pedestrian Collision Warning and Context Aware recommendation. The team also visited some of the laboratories of Computer Science and Electrical Engineering Department.

STUDENTS' RESEARCH

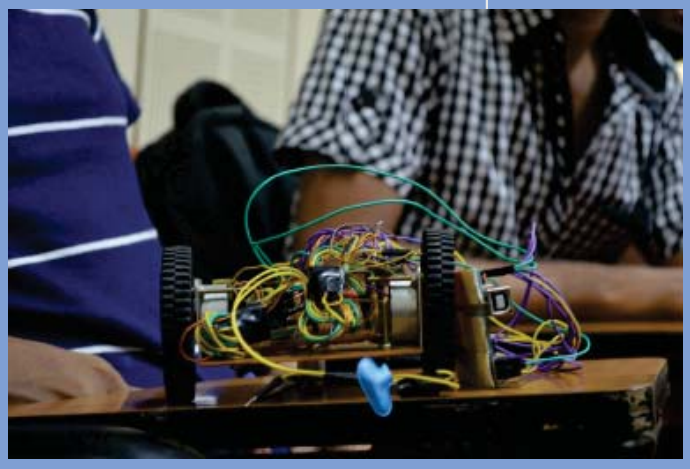
Electronics Club

Swarm Robotics

This project is based on the idea of mimicking the natural swarms (eg. ants, honey-bees etc.) through a group of mobile robots, forming a decentralized system and exploring the environment through their sensing ability, mutual interaction and capability of communication wirelessly.

Hand Gesture Recognition (EMG)

This is a Bioinformatics based project,which utilises the body signals (muscle contraction, relaxation, etc.) through various postures of hand, and thus control physical devices through body gestures. We were able to detect Five distinct hand gestures.



SIIC Success Stories

Apcegen Technologies Private Limited, an Incubate Company at SIIC, has been awarded the ISBA Rising Star of the Year Award for 2016 under the category of Life Sciences, Pharmaceutical, Biotechnogy and Healthcare. Apcegen is a technology oriented Biopharma development organization nurtured by a group of highly trained and qualified technocrats with vast experience in bioprocess development of various biopharmaceuticals. Apcegen Technologies is currently focusing on the development of a battery of recombinant therapeutics aimed to combat diseases like Rheumatoid Arthritis and Cancers and works on the development of protein based chip which will be useful for the diagnosis and treatment of life threatening diseases like Anemia related to Cancer, Renal failure and Diabetes. The company is promoted by Mr. Ashutosh Vyas and mentored by Prof. Ashok Kumar and Prof. Amitabha Bandyopadhyay, Biological Science and Bioengineering , IIT Kanpur.

PROMORPH SOLUTIONS played a vital role in changing the Educational Landscape of Government Schools of Giridih District in Jharkhand by developing monitoring and governance solution for *Quality Education* leveraging *Technology and Analytics*. They have developed "DISHA" mobile app and analytical web application for this purpose. This initiative has received high appreciation. The company has presently covered 1300 government schools for middle and high school in the first phase. In the second phase, it will be extended to 2200 more schools and will also cover the primary schools.

link for media coverage is https://www.youtube.com/watch?v=E_sq7jqYb1I&feature=youtu.be

Huro

The objective of the project was to build a wheeled humanoid and implement speech recognition, image processing and sound localization on the robot. The team aspires to participate in the Huro Cup. They are currently working on the project with a new and improved design, biped and better image processing capabilities.

WASP

The aim of this project was to make a robot that would identify it's location in space with respect to the accessing points using ESP-8266 WI-FI module and the robot would then traverse to the required location in an obstruction free space as per the input location of the user using, method of trilateration.

Recently Registered Projects

Coding of Innate Olfactory Preferences in the Mosquito Brain

PI: Prof. Nitin Gupta, Dept. of Biological Sciences and Bioengineering

Sponsor: Wellcome Trust - DBT India Alliance

Mosquitoes detect humans using a variety of cues, including the exhaled carbon dioxide and skin odors. Presently, the understanding about how the information relayed by the sensory neurons is processed in the mosquito brain and how it results in specific behavioral preferences is lacking. In this project, an electrophysiology lab will be established and technique of in-vivo intracellular recordings for mosquitoes will be optimized. By measuring the responses of projection neurons to attractive, repulsive and neutral odorants and examining their morphologies, it will be tested whether different attractive and repulsive odors are encoded by dedicated neural pathways.

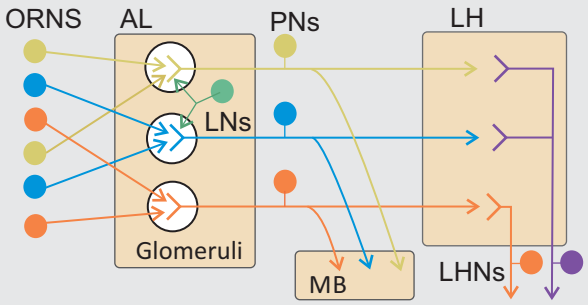


Figure : Schematic of insect olfactory system. Olfactory receptor neurons (ORNs) detect odors and carry information into different glomeruli in the antennal lobe (AL). Local neurons (LNs) provide lateral connections between glomeruli. Projection neurons carry information from AL to the mushroom body (MB) and the lateral horn (LH).

Kinetics of Microstructure Evolution in Brazing Joints of 0.07C-16Cr-6Ni Steel and Silver with Ag-Cu-Sn Filler Metal

PI: Prof. Kaustubh Kulkarni, Materials Science and Engineering

Co-PI: Mr. T. Venkateswaran, VSSC Thiruvananthapuram

Sponsor: Vikram Sarabhai Space Center, ISRO

In developing new cryo- and semi-cryo engine technologies, joining of dissimilar materials is a critical issue that needs to be addressed. In this project, joining of an austenitic martensitic stainless steel with pure silver, silver-copper alloy and aluminum bronze was studied. Optimum brazing temperatures were determined based on the evolution of microstructure in the joint and properties developed in the joint. Post brazing heat treatment was also designed to recover the properties of the base steel. Observed alloy partitioning as well as mechanism of improved wetting behavior of the brazing filler material in presence of nickel coating was explained based upon the diffusional and thermodynamic interactions among the various components.

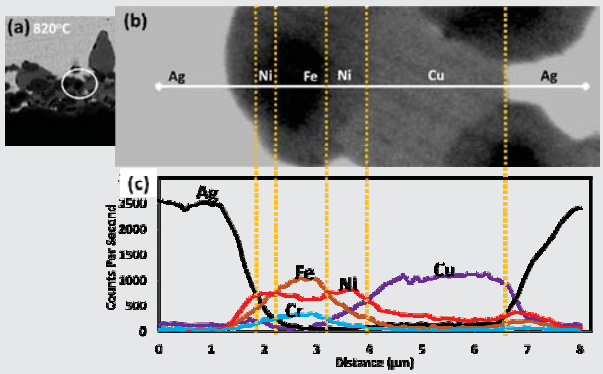
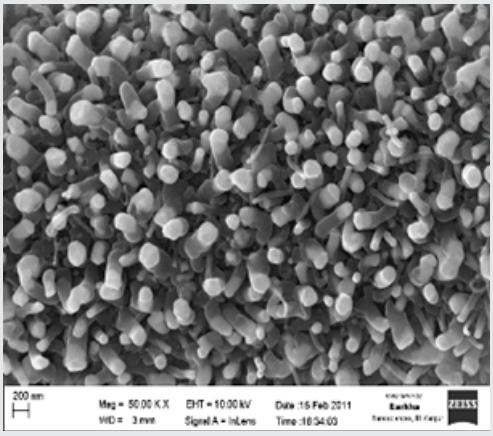


Figure: (a) and (b) BSE micrograph of the joint region close to the interface with stainless steel. (c) Concentration profile taken across the joint clearly reveals the partitioning of iron and chromium away from copper and silver due to the positive thermodynamic interactions between them. Nickel, having almost negligible reaction with both iron and copper nicely separates the iron-rich and copper-rich regions

Development of Transition Metal-doped Carbon Nanofiber-based Biosensor for the Detection of Glucose, Cholesterol, and Creatinine in Human Blood

PI: Prof. Nishith Verma, Dept. of Chemical Engineering

Sponsor: Department of Biotechnology (DBT), India



The selective determination of bioactive solutes such as cholesterol, glucose, and creatinine is significant for the medical diagnosis, and at present, most of the research for biosensors is focussed around the fast and sensitive determination of these analytes present in the blood. In this study, the transition metal-carbon nanocomposite material is to be prepared as a stable, high performing and economically viable electrode material of a biosensor for the simultaneous detection and measurements of glucose, cholesterol, and creatinine in biofluids. The electrode material will be prepared by catalytic chemical vapor deposition, using activated carbon microfiber as a substrate. The proposed biosensor will be tested on human blood samples in a clinical environment, using an electrochemical cell assembly and amperometric techniques. This is the first time that the synergetic effect of the hierarchal web of activated micro-nanofibers (ACFs/CNFs), transition metal and metal oxide NPs, and cholesterol/glucose oxidase (ChOx) is to be demonstrated for the amperometric detection of cholesterol/glucose and creatinine. One of the bimetal NPs performs the dual role of catalyzing the CNF growth and capturing electrons from the oxidation of analytes. The other type of the metals is attached to the base of ACFs and its inclusion is to increase the sensitivity and current-response of the biosensor. The SEM image here shows the Ni NPs located at the tips of the grown CNFs on ACF present in human blood.

Interface Engineering and Development of Hole-Transporting Materials for Perovskite Solar Cells

PI: Prof. Raju Kumar Gupta, Dept. of Chemical Engineering

Co-PI: Prof. Anand Singh, Dept. of Chemistry

Prof. Ashish Garg, Dept. of Materials Science & Engineering

Sponsor: Department of Science & Technology (DST), India

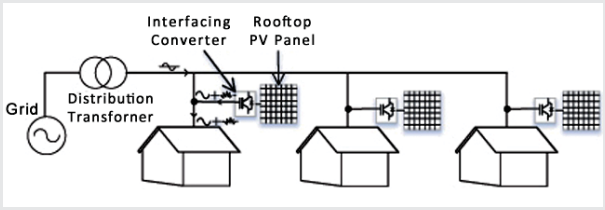
The recent emergence of efficient solar cells based on perovskite absorbers promises to transform the field of solar energy harvesting. Though, power conversion efficiency over 20% for single junction perovskite solar cells has been achieved, various questions remain unanswered with regards to understanding of these materials. Poor reproducibility of results and degradation rate are often attributed to the morphology and the quality of perovskite film formation. The overall objective of this proposal is to understand film formation of the perovskite materials and in-house synthesis of new hole-transporting layer for perovskite solar cells. Perovskite solar cell devices will be fabricated under controlled environment and will be characterized for power conversion efficiency, quantum efficiency etc. Finally, device life time will be measured under various environmental stress conditions.

Recently Registered Projects

Harmonic Compensation using Distributed Solar PV Inverters


PI: Prof. Sandeep anand, Dept. of Electrical Engineering
PI: Prof. Saikat Chakrabarty, Dept. of Electrical Engineering
Sponsor: Clean Energy Research Initiative (CERI), DST

Solar PV generates dc voltage and requires a dc-ac converter (inverter) before interconnection with the ac grid. Various inverters are commercially available for direct feeding of solar PV power into the grid without storage. Most of these inverters operate at unity power factor (UPF) with low value of current total harmonic distortion (iTHD). This avoids flow of harmonic current from/to these inverters. However, there are various other loads installed in the vicinity of these inverters, which would be injecting harmonic currents in the network. This case is common for distributed generation, where solar PV is installed close to residential, commercial or industrial loads, as shown in the figure below. Flow of harmonic currents in distribution lines, feeders and transformers increases power loss, reduces power quality and leads to underutilization of the grid infrastructure. During morning, evening and night, capacity of the solar inverter is not utilized completely, due to less availability of solar irradiance. The aim of this proposal is to utilize the remaining capacity of the solar inverters for harmonic compensation. This would help compensating the harmonic currents drawn by the loads, thereby reducing losses and improving power quality in the ac grid.



Key objectives of the project :
(I) Analysing the role of harmonics in a distributed generation system,
(ii) Identifying challenges and solutions for integrating harmonic current compensation techniques in solar PV inverters,
(iii) Development of working solar PV inverter prototype with harmonic current compensation feature.

Integration and Enablement of 0.18micron RF-SOI Technology for Analog Mixed-Signal Applications

Prof. Yogesh Singh Chauhan, Dept. of Electrical Engineering
Sponsor: Department of Science & Technology (DST), India

The project is an endeavor towards “Make in India” for an RF-SOI technology that will enable manufacturing of superior integrated circuits (IC) in India, especially for analog & mixed signal RF applications, such as cell-phones, radars, and set-top boxes. Split lot experiments, test structure characterization, process/device simulations, and compact modeling will be carried out to achieve project objectives. It will create production level RF-SOI Analog Mixed-Signal (AMS) technology for the first time in the country through collaboration between academic institute (IIT Delhi) and Govt. laboratory (SCL) and will create PDK and offer country’s first multi-project wafer (MPW) service. Project will be undertaken in collaboration with IIT Delhi and Semi-Conductor Laboratory (SCL), Chandigarh - a semiconductor fab under Department of Space, Govt. of India.

Optical Diagnostics of Transport Phenomena during Gas Hydrate Formation and Dissociation


PI: Prof. Malay K Das, Dept. of Mechanical Engineering
PI: Prof. P.K. Panigrahi, Dept. of Mechanical Engineering
Sponsor: Oil and Natural Gas Corporation Limited

The present proposal deals with the laboratory-scale experiments of CH_4 extraction from the marine hydrate sediments. The idea is to visualize the physical phenomena as well as to measure the methane fluxes during formation and dissociation of CH_4-hydrate. The proposed experimental techniques focus on concentration-field reconstruction of laser schlieren imaging and X-ray tomography. The primary objectives of the proposed research include:

- Laboratory-scale evaluation of Methane recovery strategies
- Providing a test-bed for new technologies
- Supplying benchmark results for the (computational) reservoir simulators

Experimental Techniques

Proposed experimental technique involves developing methane-hydrate in laboratory environment and then recovering the CH_4 from its hydrate via depressurization and CO_2 injection. The typical experimental setup is shown in Figure 1.

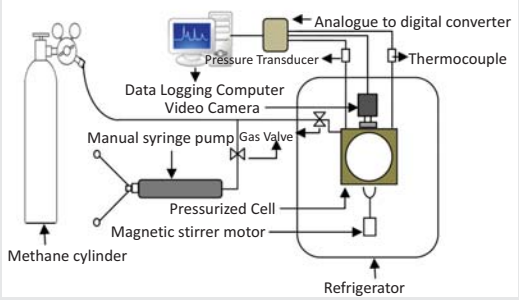


Figure 1. Proposed experimental setup for gas hydrate formation and dissociation

Hydrate forms with the pressurized cell, as shown in the Figure 2. Again, methane is released as the pressure in the cell is reduced below the thermodynamic equilibrium. During the formation and depressurization of hydrate the gas phase of the high pressure reactor will be subjected to schlieren imaging, as shown in Figure 2. Additionally, the hydrate phase will be subjected to X-ray microtomography imaging. The schlieren image will be analyzed quantitatively to recover the concentration field.

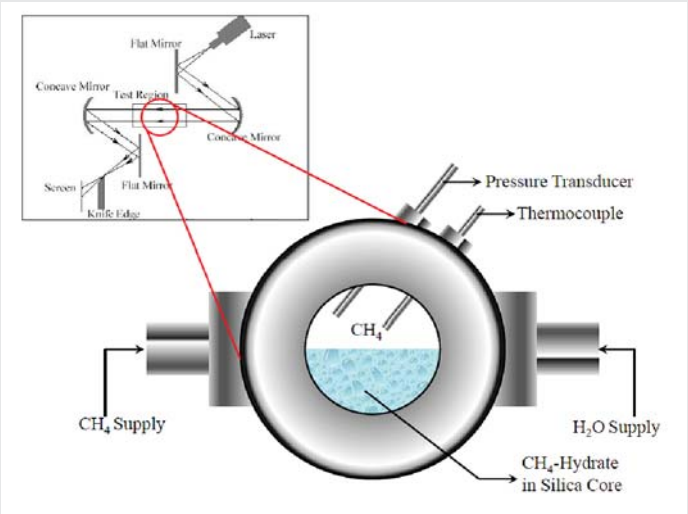


Figure 2. The hydrate cell subjected to schlieren imaging

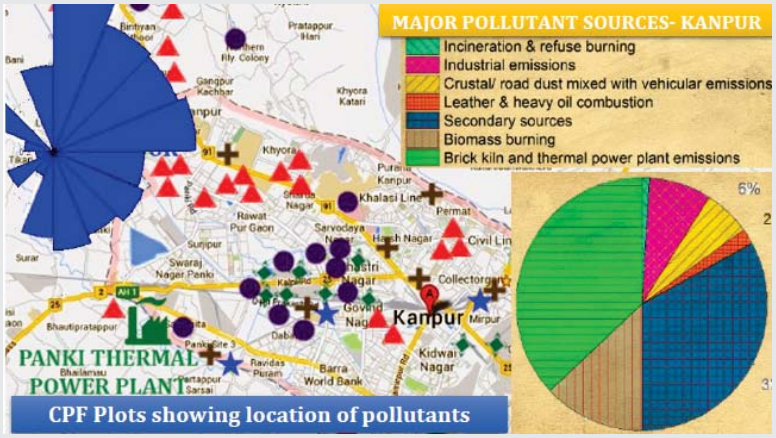
National Carbonaceous Aerosols Programme (NCAP): Carbonaceous Aerosol Emissions, Source Apportionment and Climate Effects



PI: Prof. Tarun Gupta, Dept. of Civil Engineering
Co-PI: Prof. Anubha Goel, Dept. of Civil Engineering
Prof. Debajyoti Paul, Dept. of Earth Sciences

Sponsor: Ministry of Environment, Forest and Climate Change

Carbonaceous aerosol emissions arise from energy use and the burning of forest, grasslands and agricultural residues. The emissions lead to air-quality degradation and related health-risks on local to regional scales and to climate impacts on regional to global scales. In south Asia, there is dominance of small combustion sources (e.g. residential cooking and heating), less-developed industry (e.g. brick kilns), and vehicular emission. The broad objectives of this major national initiative involving more than a dozen institutes are extensive understanding of carbonaceous aerosol emissions from regional sources including emission inventory, source apportionment, and their seasonal and long-term atmospheric abundance. Specifically, IIT Kanpur will be estimating emission magnitude and uncertainty of carbonaceous aerosols and co-emitted species from major vehicular tail pipes. In addition, an inverse modelling methods will be employed with the aid of molecular markers and isotope finger printing for deducing regional atmospheric abundance of carbonaceous aerosols, measured over a two year long period, from two North-East Himalayan sites.



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